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# Adapting Sustainable Forest Management to Climate Change: Preparing for the Future



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# Adapting Sustainable Forest Management to Climate Change: Preparing for the Future

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Canadian Council of Forest Ministers  
Climate Change Task Force

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## Canadian Council of Forest Ministers

Climate Change Task Force

***“Consideration of climate change and future climatic variability is needed in all aspects of sustainable forest management”***


*A vision for Canada's forests: 2008 and beyond*

(CCFM 2008)



Photo: Natural Resources Canada





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Photo: Jason Edwards

## FOREWORD

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Canada has 397 million hectares of forests and other woodlands, representing 10% of the world's forest cover. Our forests constitute a world-class natural treasure providing ecological, economic, social, and cultural benefits to all Canadians, regardless of whether they live in small northern communities or large urban centres. Canada is committed to sustainable forest management, which aims to maintain and enhance the long-term health of forested ecosystems while providing ecological, economic, cultural, and social opportunities for present and future generations.

One of several factors that pose both opportunities and challenges in terms of effectively and efficiently meeting our sustainable forest management goals is climate change and its inherent uncertainties. The Canadian Council of Forest Ministers (CCFM) identified climate change as one of two priority issues for Canada's forest sector. In its *Vision for Canada's Forests: 2008 and Beyond*, the CCFM stated, "Consideration of climate change and future climatic variability is needed in all aspects of sustainable forest management." In addition, to minimize the risks and maximize the benefits associated with a changing climate, Canada's provincial and territorial premiers asked their Ministers responsible for forest management to collaborate with the federal government on adaptation in forestry through the CCFM's Climate Change Task Force. Phase 1 of this work, completed in 2010, involved a comprehensive assessment of the vulnerability of various tree species and identified management options for adaptation. Phase 2 has gone beyond the level of trees to look at climate change adaptation within forest ecosystems and the broader forest sector. The goal of phase 2 was to equip members of the forest sector with a suite of tools and state-of-the-art information to enable them to make better decisions about the need for adaptation and the types of measures that may be most beneficial.

Over a period of two years, nearly one hundred individuals from a wide range of organizations have contributed to achieving this goal. The fruits of their labour have been captured in the CCFM's Climate Change Adaptation series, which comprises several technical reports and review papers. It is our sincere hope that these documents, which will be used in conjunction with workshops, seminars, and presentations, will benefit forest practitioners from coast to coast to coast as they seek innovative ways to adapt sustainable forest management policies and practices for a changing climate.

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## ABSTRACT

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Climate change is an unprecedented issue in modern times, posing a number of challenges to sustainable forest management (SFM) in Canada. These challenges include how best to plan and adapt for an uncertain future. The Canadian Council of Forest Ministers (CCFM) has recognized the need to minimize the risks and maximize the opportunities that climate change presents for Canada's forests and forest sector and has therefore initiated collaborative, interjurisdictional work on adaptation in forestry. This report briefly characterizes the issue of climate change as it relates to SFM in Canada and outlines the importance and benefits of adaptation for Canada's forest sector. Additionally, it presents the CCFM approach for adapting SFM to a changing climate and summarizes a suite of tools and products that the CCFM has developed to enhance the capacity of the Canadian forest sector to adapt to climatic changes.

**Key words:** climate change, sustainable forest management, adaptation

## RÉSUMÉ

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L'enjeu sans précédent des temps modernes que représentent les changements climatiques pose un certain nombre de défis à l'aménagement forestier durable (AFD) au Canada. Comment mieux planifier l'AFD et l'adapter aux incertitudes à venir est l'un de ces défis. Le Conseil canadien des ministres des forêts (CCMF) reconnaît le besoin de minimiser les risques que posent les changements climatiques aux forêts du Canada et au secteur forestier canadien et d'en maximiser les bénéfices. Dans cette foulée, il a démarré un travail de collaboration intergouvernemental sur l'adaptation de ce secteur d'activité. On trouve dans ce rapport-ci : 1) la caractérisation des enjeux liés aux changements climatiques qui peuvent influencer l'AFD au Canada, 2) la démonstration de l'importance du secteur forestier à s'adapter aux changements climatiques et les avantages qu'il peut en tirer, 3) la présentation de l'approche d'adaptation de l'AFD aux changements climatiques élaborées par le CCMF, 4) l'énumération des outils et produits mis au point par le CCMF en vue d'accroître la capacité d'adaptation du secteur forestier canadien aux changements climatiques.

**Mots clés :** changements climatiques, aménagement forestier durable, adaptation



## CONTENTS

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INTRODUCTION .....	1
SFM IN A CHANGING CLIMATE .....	3
Box 1: What is Sustainable Forest Management? .....	4
IMPORTANCE AND BENEFITS OF ADAPTATION .....	5
CCFM APPROACH FOR ADAPTING SFM TO A CHANGING CLIMATE .....	7
Box 2: Foundational Principles of the Canadian Council of Forest Ministers' Approach for Adapting Sustainable Forest Management to a Changing Climate .....	9
MOVING FORWARD .....	11
ACKNOWLEDGMENTS .....	13
LITERATURE CITED .....	15
GLOSSARY .....	17



## INTRODUCTION

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Climate change is an unprecedented issue in modern times, with significant implications for Canada's forested ecosystems, the economic benefits they provide, and the livelihoods of those who depend on them. Climate change is also a dynamic and complex issue that increases uncertainty about what future forests will look like. Despite this uncertainty, a forward-looking approach is needed in forest management decisions made today.

An understanding of how Canada's forests and sustainable forest management (SFM) policies and practices are vulnerable to climate change, as well as how to incorporate uncertainty into decision making, is required if Canada's forest sector is to address the challenges and capitalize on new opportunities presented by climate change. Adaptation to climate change is therefore essential for managing forests sustainably so as to keep our forest industries competitive in the global marketplace and our forest-dependent communities vibrant and prosperous.

Recognizing the need to minimize the risks and maximize the opportunities that climate change poses for Canada's forests and forest sector, the Canadian Council of Forest Ministers (CCFM) initiated, in 2008, collaborative work on adaptation in forestry. Phase 1 of this interjurisdictional initiative resulted in a review of the vulnerability of Canada's major tree species to climate change and identification of potential adaptation options (Johnston et al. 2009). Phase 2, of which this document is a part, provides tools, approaches, and state-of-knowledge information to members of Canada's forest sector to enable them to incorporate climate change considerations into all aspects of SFM.

This report briefly characterizes the issue of climate change as it relates to SFM in Canada and outlines the importance and benefits of adaptation for Canada's forest sector. In addition, it summarizes the suite of products that the CCFM has developed during phase 2 of its climate change initiative, which are intended to enhance the capacity of the Canadian forest sector to adapt to climatic changes.





Photo: Jason Edwards

## SFM IN A CHANGING CLIMATE

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SFM is based on the principle of maintaining and enhancing the long-term health of forest ecosystems while providing environmental, economic, social, and cultural opportunities for current and future generations (see Box 1). Canada is a world leader in SFM practices and is the country with the largest area of land certified as sustainably managed by third-party certification groups (i.e., Canadian Standards Association, Forest Stewardship Council, Sustainable Forestry Initiative) (NRCan 2011).

Most of Canada's forests became established and evolved under climatic conditions and processes that have changed relatively slowly since glaciers last covered much of the northern hemisphere. Canadian forests are adapted to Canada's northern climate and to a range of natural disturbances, such as forest fires and insect outbreaks. However, over the next several decades, the climate is expected to shift at a rate that will likely exceed the ability of tree species to migrate naturally (Johnston et al. 2009), and natural disturbances are expected to increase in frequency and intensity (Johnston et al. 2010). SFM planning, policies, and practices will need to take this rapid change into account.

Climate change is directly affecting the length of the growing season, growing conditions (specifically ambient temperatures and moisture regimes), winter minimum temperatures, snow conditions, the timing of life cycle events such as bud burst (i.e., phenology),

biotic disturbances (such as the frequency, intensity, and locations of insect outbreaks), abiotic disturbances (such as wildfire, extreme weather events, and drought), and site conditions (such as soil nutrients and permafrost). Climate change impacts on forested ecosystems include changes in forest health, regeneration success, growth and productivity, distribution and composition of species, forest structure, age-class distribution, quantity and quality of wood, and other ecological goods and services provided by forests. Climate change also has direct impacts on forestry operations, including shortening of the winter harvesting season and loss of ice roads, which increases operating costs.

Although climate change has some positive aspects, such as increased tree growth in some parts of Canada, these benefits are outweighed by the potential negative effects (Lemprière et al. 2008; Williamson et al. 2009; Johnston et al. 2010). Consequently, the risks to SFM as it is currently practiced in Canada are high and may have large economic impacts. For example, a first attempt at a national-level analysis of the economic impacts of climate change by the National Roundtable on the Environment and the Economy (2011) has suggested that the annual reduction in Canadian gross domestic product resulting from climate change impacts on the Canadian timber supply could range between \$2.4 billion and \$17.4 billion by 2050. Successful implementation of adaptation measures could reduce the vulnerability of Canada's economy and, more specifically, its forest sector to climate change. All of this points to the need for effective adaptation to reduce the risks and maximize the opportunities related to climate change in the context of Canada's forest sector.



### **Box 1: What is Sustainable Forest Management?**

Forests provide significant environmental, economic, social and cultural benefits to Canadians. As development pressures on forest resources have mounted over time, the need for a concept of forest management that ensures conservation of healthy forests for future generations, while allowing for a balanced, equitable, and efficient flow of environmental, economic, social and cultural benefits for current generations, became apparent. The concept of sustainable forest management (SFM) was developed in response to this need. SFM has been embraced by forest managers across Canada. Furthermore, demonstrating adherence to the principles of SFM has become an international requirement, both through international agreements, such as the Montreal Process, and through various forest management processes, such as certification.

To implement SFM and to ascertain whether it was being achieved, a clear definition of the concept and a mechanism or tool to monitor and measure progress toward it were required. The Canadian Council of Forest Ministers therefore developed a national framework of criteria and indicators to meet these dual requirements (CCFM 2006). This Canadian framework sets out six criteria for achieving SFM:

**Criterion 1.** Biological diversity

**Criterion 2.** Ecosystem condition and productivity

**Criterion 3.** Soil and water

**Criterion 4.** Role in global ecological cycles

**Criterion 5.** Economic and social benefits

**Criterion 6.** Society's responsibility

Any forest that is to be considered as being managed sustainably aims to meet these types of criteria. This is far from the largely timber-focused management approach of the past. Instead, SFM works to address and balance a wide range of environmental, economic, and social considerations so that the needs and expectations of all forest users may be met today and in the future. This comprehensive approach requires more than just dealing with the immediate challenges of the day; it also requires working to predict long-term trends so that Canadians can plan how to best maintain the health and well-being of the country's forests and forest economy.

## IMPORTANCE AND BENEFITS OF ADAPTATION

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Much of the initial work related to climate change, both internationally and nationally within Canada, has focused on greenhouse gas emissions and efforts to reduce the rate and amount of climate change. Climate change mitigation remains an important goal to which Canada's forests can make an important contribution. However, given the climate change impacts described above, there has been increasing emphasis on the need for concurrent adaptation actions to be undertaken immediately. Adaptation has been defined as "the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (Parry et al. 2007).

Adaptation can reduce the vulnerabilities and risks associated with climate change. This is particularly true for SFM, given the broad, cross-cutting, interacting, and cumulative effects of climate change on forests and forest management operations. However, adaptation will require systems-based thinking, a forward-looking approach, and the ability to make informed decisions about the future despite many uncertainties. Adaptation is not simply an add-on to SFM; rather, it is embedded within all aspects of this management approach, from policy to practice.

To mainstream climate change adaptation into SFM, more advanced tools, mechanisms for sharing knowledge about impacts and adaptation, and promotion of communication, education, and knowledge exchange across the Canadian forest management community are needed, and it is these needs that the CCFM climate change initiative is helping to address.



Photo: EMEND Project, University of Alberta



•Photo: Jason Edwards



## CCFM APPROACH FOR ADAPTING SFM TO A CHANGING CLIMATE

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The work of the CCFM in this area has been done by an interjurisdictional team known as the CCFM Climate Change Task Force. The task force has focused on the development of tools, products, and approaches to inform and support forest managers in addressing climate change impacts on SFM. Recognizing the differing mandates, roles, and responsibilities of the various jurisdictions in Canada, this work is relevant to policy making, but does not prescribe or dictate specific policies.

The results of this work are presented in a collection of documents informally known as the Canadian Council of Forest Ministers Climate Change Adaptation series. A primary goal of this series is to aid forest practitioners in incorporating climate change adaptation into their SFM activities. The reports focus on enabling forestry organizations to assess the various implications of climate change on SFM and are based on a set of foundational adaptation principles (see Box 2).

Brief descriptions of the other forthcoming reports in this series are provided below.

### ***Adapting sustainable forest management to climate change: a systematic approach for exploring organizational readiness.***

Managing the adaptation of complex socio-ecological systems requires flexibility and adaptability to unexpected changes. Exploring an organization's readiness is an important first step in proactively managing for climate change. This report provides a framework to help organizations assess the degree to which they can adapt to a rapidly changing climate. It also provides a structured thought process that organizations can use to determine their willingness and capacity to undertake a vulnerability assessment and to implement adaptation options.

### ***Adapting sustainable forest management to climate change: a framework for assessing vulnerability and mainstreaming adaptation into decision making.***

Vulnerability assessments integrate information about a system's sensitivity and exposure to climate change, as well as its ability to adapt. Such assessments are used around the world as a basis for informing policies and practices related to climate change adaptation but have not been comprehensively applied to SFM in Canada. This document presents a flexible and broadly applicable assessment framework that will enable forest managers to better understand how SFM is vulnerable to current and potential future climatic conditions and how such information can be incorporated into adaptation decision making on an ongoing basis.

### ***A practitioner's guide for assessing sustainable forest management vulnerability and mainstreaming adaptation into decision making.***

This guidebook provides practical "how-to" advice to aid forest practitioners in applying the CCFM approach to vulnerability assessment and adaptation planning for SFM. It offers step-by-step details on completing vulnerability and adaptation assessments and includes easy-to-follow worksheets and numerous examples from SFM adaptation assessments already under way in Canada.

### ***Adapting sustainable forest management to climate change: scenarios for vulnerability assessment.***

In the face of an uncertain future climate, scenarios constitute one important tool that decision makers can use to explore potential changes in future climate and their anticipated impacts on forests and forestry. Such scenarios allow managers and other stakeholders to evaluate the potential consequences of a changing climate that could have significant effects on SFM and, hence, on the social and economic benefits that forests provide. This report explains what scenarios are, examines the different types of scenarios that exist or can be created, and describes how they can be used in vulnerability assessments to explore the impacts of climate change on SFM and to develop robust adaptation strategies.

***Adapting sustainable forest management to climate change: an overview of approaches for assessing human adaptive capacity.***


Evaluating the capacity of the human elements of an SFM system to adapt to climate change, whether that system is a company, a community, or a government, is essential to any SFM vulnerability assessment. This report introduces the concept of adaptive capacity and it provides an overview of approaches for describing adaptive capacity, determining its sufficiency relative to current and future needs, and identifying actions to increase the ability to adapt to climate change. Relevant case studies are reviewed to provide tangible illustrations.

***Adapting sustainable forest management to climate change: an analysis of case studies from across Canada.***

Drawing on a number of vulnerability assessment initiatives from across Canada, this report provides a comprehensive synthesis and analysis of the best practices and lessons learned by those who have undertaken vulnerability assessments associated with various aspects of SFM. Many of these projects are testing all or parts of the CCFM approach to adapting SFM to a changing climate.



Photo: Jason Edwards



### **Box 2: Foundational Principles of the Canadian Council of Forest Ministers' Approach for Adapting Sustainable Forest Management to a Changing Climate**

The Canadian Council of Forest Ministers' approach for adapting sustainable forest management (SFM) to a changing climate provides a path forward in preparing for an uncertain future and is based on the following foundational principles:

- Climate change and future climate variability should be considered in all aspects of SFM in Canada.
- Systematically evaluating organizational readiness prepares organizations, whether public or private, for the challenges of climate change adaptation.
- Assessing the vulnerability of SFM in Canada to climate change at different scales (from local to national) can lead to more effective and efficient adaptation decision making.
- Using scenarios can help forest managers and other stakeholders to develop robust adaptation plans and to identify "no-regret" adaptation options and will inform decision making for an uncertain future.
- SFM planning in a changing climate requires decision making based on adaptive management or continuous improvement practices that include sound science and analyses, as well as expert opinion, the use of climate-relevant indicators, and systems to measure and track the effectiveness of adaptation actions.
- The capacity of the forest sector to adapt to climate change will be strengthened by new research and development related to climate change adaptation, by interorganizational collaboration and cooperation, and by the sharing of adaptation knowledge, experiences, best practices, and lessons learned.



Photo: Jason Edwards

## MOVING FORWARD

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Climate change poses a number of challenges to SFM in Canada, especially in terms of deciding how best to plan and adapt for an uncertain future. New approaches to SFM are being developed, and forest managers are seeking innovative tools to support decision making in a changing climate. With the new suite of CCFM products in their toolbox, forest managers will be better able to understand the vulnerability of SFM to climate change and will also be better equipped to assess the benefits and limitations of potential adaptation policies and practices. To ensure their wide applicability, these tools, products, and approaches are relatively generic, and users are encouraged to adjust and adapt them to meet their own specific needs and circumstances.

Adapting SFM to a changing climate requires a proactive and collaborative effort by all members of Canada's forest sector. The CCFM is contributing to this effort by providing a common approach to adaptation that forest managers and practitioners across Canada can apply to ensure that climate change considerations are included in all aspects of SFM.



Photo: Natural Resources Canada





Photo: Jason Edwards

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Photo: Jason Edwards

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Photo: Jason Edwards



## GLOSSARY

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**Adaptation** | "Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (Parry et al. 2007).

**Adaptation options** | Potential actions or activities to address or reduce the vulnerabilities identified in a vulnerability assessment.

**Adaptive capacity** | "The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences" (Parry et al. 2007).

**Adaptive management** | "A systematic process for continually improving management policies and practices by learning from the outcomes of previously employed policies and practices" (MEA 2005).

**Climate** | "Climate in a narrow sense is usually defined as the 'average weather', or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. The classical period of time is 30 years, as defined by the World Meteorological Organization (WMO)" (Parry et al. 2007).

**Climate change** | "Climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC), which defines 'climate change' as: 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global

atmosphere and which is in addition to natural climate variability observed over comparable time periods" (Parry et al. 2007).

**Climate variability** | "Variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events. The term is often used to denote deviations of climatic statistics over a given period of time (e.g. a month, season or year) from the long-term statistics relating to the corresponding calendar period. In this sense, climate variability is measured by those deviations, which are usually termed anomalies. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability)" (WMO n.d.).

**Forest sector** | "The forest sector includes governments, conservation and environmental groups, woodlot owners, Aboriginals, urban forestry interests, lumber and pulp and paper producers and value-added industries, forest-reliant communities, the recreation and tourism industries, and other sectors of the economy (including the energy, chemical, and pharmaceutical industries) that derive wealth and well-being from Canada's forest resources" (CCFM 2008).

**Mainstreaming adaptation** | Inclusion of climate change considerations in day-to-day decision-making and management on a continuous and ongoing basis.

**Scenarios** | "A plausible and often simplified description of how the future may develop, based on a coherent and internally consistent set of assumptions about driving forces and key relationships. Scenarios may be derived from projections, but are often based on additional information from other sources, sometimes combined within a 'narrative storyline'" (Parry et al. 2007). Scenarios are not predictions, and they typically do not include prediction errors or likelihoods.

**Sustainable forest management** | "Management that maintains and enhances the long-term health of forest ecosystems for the benefit of all living things while providing environmental, economic, social, and cultural opportunities for present and future generations" (CCFM 2008).

**Vulnerability** | "The degree to which a system is susceptible to, and unable to cope with, adverse effects of

climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity" (Parry et al. 2007).

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